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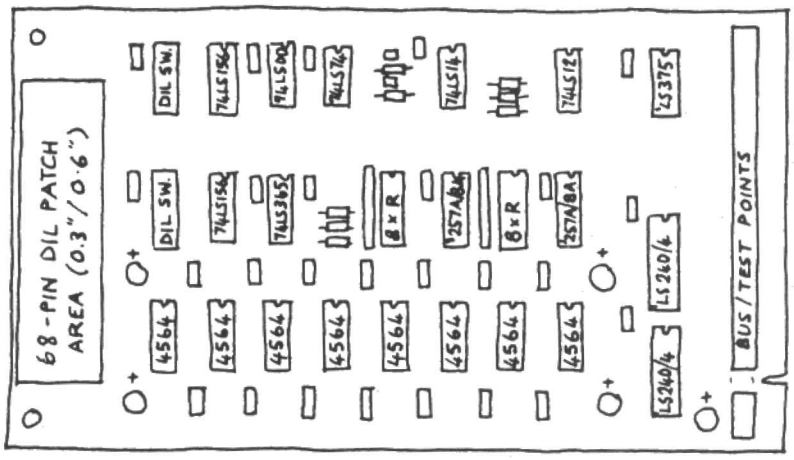
Interak 1

DRM-64 RAM

64K Dynamic RAM Card using Z80A Refresh



64K Dynamic RAM Card using Z80A Refresh

DRM-64 FEATURES

* Recommended Interak 1 RAM Card.
* Uses Latest 5V-only 150ns 64K x 1 7-bit Refresh Dynamic RAMs.
* Simple Design - Based on the Earlier Kemitron 16K Card which has Proved Itself for use at 4.0 MHz Without Wait States.
* RAS-Precharge Extender Circuit Built in (Rigorous Design).
* Uses No Special Controller Chips - Cheap and Easy to Build and Service.
* Uses Z80A Refresh Control for Transparent Refresh.
* Can be Disabled on up to 16 4K "Pages" by means of miniature DIL Switches (Included in Price).
* ISBUS-A, INTERAK 1, KBUS-5 and KBUS-12 Bus Compatible.
* International Size Card (4.5" x 8").
* Provision for Mounting of Metal Card Front.
* Epoxy Glass PCB, with Plated-through Holes.
* Gold-Plated 0.1" Pitch Edge Connector on both "A" and "B" sides.
* Green Solder Resist Coating.
* 68-pin 0.3"/0.6" DIL Patch Area Provided for User's Own Purposes.
* Needs Only a Single Rail 5V Supply.
* Calculated Supply Current 400 mA typical, 700 mA max.
* Buffered Where Necessary to Reduce Bus Loading to 1 "LS" Load per Line.
* First Introduced in 1983 - proven design.
* No Manufacturer's Name Appears on the Card, so it is Ideal for OEM Use.

DESCRIPTION

The DRM-64 is an Interak Card, which has been designed specially to suit the INTERAK 1 System, using simple straightforward techniques and readily available components such as the 74LS series ICs.

The DRM-64 is the natural choice for the RAM in a new Interak 1 system, since it offers up to four times the memory of the earlier Kemitron Electronics Ltd MXD-2 16K Dynamic RAM card, at about the same price; as a bonus it requires only a single 5V power supply instead of the MXD-2's multi-rails. Although it is still stocked the MXD-2 card is thus effectively obsolete, and is only of use when users already have surplus chips (type 4116) to suit the MXD-2. If you are interested in the old MXD-2 card we can supply a brief description sheet free of charge. Now that the price of the 64K chips has fallen to its present low level the DRM-64 card is usually the best choice even if much less than 64K of RAM is required; provision has been made on the board to permit up to 16 4K "pages" to be disabled on the board, so that its effective size can be tailored from OK to 64K.

Bus Allocations

The DRM-64 Card suits all of the known bus standards for this type of card, namely KBUS-5, KBUS-12, and ISBUS-A and B.

Address Decoding

Because the DRM-64 card occupies the entire natural 64K address space of the Z80A-CPU address decoding is not an essential part of the design.

However the use of the DRM-64 64K card in a system which does not require the full complement of dynamic RAM causes no embarrassment, as the on-board DIL switches allow up to sixteen 4K "holes" to be made in areas where there would otherwise be a conflict. Examples of such areas are those where EPROMs are in use, the VDU-K video RAM, programmable character generator RAM (if fitted), and any places for the user's own circuits (e.g. CMOS battery-backed up RAM). Also, with the introduction of the new SBC-1 single board computer card, it can be advantageous during the development of new applications for the SBC-1 to bring the EPROM and RAM on the SBC-1 into the system, for testing.

Refresh

The outstanding ability of the Z80A and enhanced versions of the Z80A such as the Hitachi HD 64180, to refresh dynamic RAMs is not wasted here, and the system CPU is used as the refresh controller, since this feature comes at virtually no charge. In the case of the Z80A, it refreshes the Dynamic RAMs "transparently" at a time (just after the Op-Code fetch cycle) when the Z80A would otherwise not be using the bus. Since the refresh is transparent, there is nothing to be lost, and the Z80A can maintain its high speed regardless of whether it is refreshing Dynamic RAM or not. A different approach is used in the HD 64180 "super Z80": here the refresh rate is programmable; the normal Z80A op code fetch has been shortened and the refresh cycle inserted asynchronously whenever an internal programmable controller decides a refresh should take place. The effect of all this is that the HD 64180 runs faster than the equivalent Z80, but this is all the same to the DRM-64, because it is correctly refreshed whatever CPU is in use.

Use was not made in this design of a dedicated refresh controller chip because such chips cost so much more, and do not give any worthwhile performance benefits on a 64K card like this. If the job of refresh control is turned over to such a chip special arrangements have to be made to synchronise it with the the Z80A refresh anyway, so that refresh can be transparent. If the chip is given total control there is the danger that it will produce wait states of its own whenever it feels it must, which may ruin some other activity (such as the writing of data to a floppy disk, or video RAM) unless tedious extra restrictions are imposed.

Simple Design

The card is of very simple design, and because it needs only one bank of 8 RAM ICs, it needs only a very simple control circuit, employing resistor-capacitor and "gate" delays for timing. (When more chips are packed onto a card these simple techniques are no longer so straightforward because signals on the board now travel along multiple paths; the time delays are then too critical to be achieved by simple means and the cost and complexity goes up).

Choice of the RAM Chips

Some people refer to these RAMs as 4164s but we previously preferred to call them 4564s because we thought this was less ambiguous.

One manufacturer, Mostek, (a multi million dollar coprporation but now out of business) introduced their own 4164 very early, with a special feature on pin 1, perhaps hoping it would be universally adopted (to repeat their success when their own design of 16K RAM chip was the one which took over from all others, making them the multi million dollars we referred to). Sadly for them it wasn't and they had to change and make the more common version: having used the number 4164 they had to find a new one, 4564, for what many others called 4164.

Another manufacturer, Texas Instruments (later to be joined by a far Eastern firm Samsung), also hoped their own version of the "4164" would become the standard. They haven't given up trying yet as they still manufacture it, but note that the Texas 4164 is unsuitable on this card because it requires an 8-bit (256 row) refresh: the Z80A most of us are familiar with can only provide a 7-bit (128 row) refresh (this was very short sighted of Zilog who invented the Z80 - serve them right if they lose their multi-million dollars too, if they ever had any. Perhaps their plan was to design this deliberate weakness into the Z80, so that when memories became bigger, as they surely do, everyone would have to switch over from the Z80 to something better, a Z800 say.

Nobody's Fools

Well if that was the plan it backfired, memories became bigger but we all carried on with the Z80. (We would even have had a Z800 but evidently Zilog had their sights on higher things, Z8000, Z80000, and abandoned the Z800, more fool them.) The Japanese, who are nobody's fools, made the RAM chips to suit and in the main the Japanese manufacturers all make the part we want, but continue to complicate the issue by calling it any number but 4164 or 4564. We used to prefer to call the part 4564, since this is a pretty obvious sounding number for a 5 Volt 64K RAM, but the rest of the world has decided otherwise, and so we will fall in with them. The parts are now quaintly known as "4164 (Texas/Samsung)", which are unsuitable, and "4164 (Not-Texas or Samsung)" which are.

Beware that even if you have a CPU chip which provides a full 8-bit refresh (eg the HD 64180) you still cannot use the Texas type of RAM on this board without modification. This is because the multiplexing on the DRM-64 was designed, in a moment of weakness, also to accommodate the 5V 16K DRAM chips type 4516, which were a really hot property, being the chosen RAM chips in the famous BBC computers. Nowadays the BBC computers have ceased to be the hot property they were, so there is no kudos attached to being able to using BBC chips on the DRM-64 card, so we now regret that we altered the address multiplexing in that moment of weakness - we should have had the courage of our convictions and done it the way we thought was best.

It is therefore a feature of the DRM-64 that it can be a 16K RAM card as well as a 64K RAM card, but as those 16K chips cost more than 64K chips, it is a feature we only whisper about, and then only when no-one is listening.

Access Times

Provided RAMs having an access time of 150ns or less are used, the system can be guaranteed to operate at a full Z80A clock rate of 4.0 MHz with no "wait" states. Practical experiments show that typical 200ns RAMs work without difficulty, but we think it is not worth taking a chance because if the slower memories don't happen to work in your case you will be marooned with a set of useless RAMs. (It is vital to ensure the use of at least a 4 MHz clock frequency without wait states if the use of double density 8" disks is contemplated: there is generally no such worry with single density formats and the smaller sizes of diskettes because they usually work at only a half or quarter of the 8" double density rate.)

In any event the "suck it and see" approach cannot be advocated by us for choosing RAM access times; it has to be calculated. This is because the Z80A and similar CPU chips have very rich instruction sets, with hundreds of different permutations of types of operation. The chances of a "suck it and see" person (ie a "sucker") happening to land on the worst case instruction in the worst case RAM location, are, by Murphy's Law, very remote. Anyway, nowadays the required 150ns RAMs are very easy to come by at very cheap rates. (The price of 64K RAMs when this board was designed was, believe it or not, a couple of hundred pounds for a set of 8! You've never had it so good!)

General

All of the components used are readily available, and expected to remain so for years to come. The integrated circuits used are all laid out the same way round, which makes the card very straightforward to construct and

test. Wherever possible signal tracks which have to pass between the legs of ICs are taken on the A-side where they can be inspected in the event of trouble. (If such tracks had been located on the B-side they would often have been hidden beneath the IC sockets, which would have had to be de-soldered to allow inspection if short circuits were suspected.) The card is made from epoxy-glass material with plated through holes. Although all of the bus connections are made via the A-side gold-plated edge connector, a similar connector is also provided on the B-side.

A "gridded" power distribution is used with "earth plane" or "power plane" areas. The need for such care with layout details is what makes reliable dynamic RAM design such a black art. (If the user wishes to keep up the good work he is recommended to do us a favour and locate this card close to the CPU card in the system so that there is not a long length of backboard connection between the two.)

You may scoff but luck does play a part in a good dynamic RAM design (and like the lucky golfer, the more we practice the luckier we get!) How else then do you explain that our board works reliably even though we use sockets for all of the chips? Less "lucky" designers have to own up to the fact that the chips on their RAM boards have to be soldered in, and they just won't work with the RAMs in sockets!

Mega-Amps

One well respected designer of a modular computer system akin to Interak, described in a learned technical journal, a man who will remain nameless here to spare his blushes (and to save us from a libel action!) explains his theory that sockets cannot be used because the rate of change of current in dynamic RAMs is around 100 Mega-Amps per second, which causes 0.8V drops in signals passing through IC socket pins even with inductances of 0.8nH! This is all as may be, but it is interesting that the said guru's design uses 74LS157/158s for multiplexing (we use 74LS257A/258A's, which have several times the driving ability, essential for these complex loads), he has crammed the memory on the CPU card, with no space for gridded power supplies and ground plane areas, and worst of all he has not put in any damping resistors in the DRAM chip lines - very advisable we would have thought with all those Mega-Amps flowing around!

Whatever the technicalities, we are pleased to report that our DRM-64 does work with socketed RAMs, so as some people say this is impossible, we're obviously not as daft as we're cabbage looking! (Mind you we must own up to the fact that we had to go through several prototypes before we devised an acceptable track layout and group of terminating and damping resistors, so it wasn't all luck, some sweat was involved too.)

Of course the sockets we supply aren't just any old 8nH sockets, they are low profile sockets which make particularly good contacts (you should see the state of my finger-nails when I pull a chip out) so to be on the safe side you'd better use our sockets!

CONTENTS OF KIT

The kit of components, which is sold separately from the p.c.b. itself, includes 8 resistors, 2 DIL and 2 SIL resistor networks, 2 DIL switch packs, 33 capacitors, 20 integrated circuits and 28 integrated circuit sockets (including sockets for the DIL resistor packs and the DIL switches).

A possible option is a 1" card front, fitted mainly for cosmetic purposes, but also to keep out dust. Some of the cards in the system require a 2" front panel, and the RAM card is ideal for fitting into the spare socket behind such a panel, to avoid wasting a valuable back-board edge connector socket position.

ORDERING INFORMATION, PRICES

Bare Board, order as "BDRM64"	18.75	+ VAT
Manual, order as "MDRM64"	2.00	(0% VAT)
Kit of Parts, order as "PDRM64"	29.92	+ VAT
Detailed Component Price List, order as "DRM64/P"	no charge	

Note that even though the board is now well established, we have not prepared a full manual. The board is supplied with enough information to assemble and use it, but users who order the manual will be supplied with all the information available at the time, with updates as they are produced, until they have a full manual.